Abstract - The teaching materials, laboratory exercises, and the whole assessment system of the Personal Computer Applications (PCA) course, in the professional study of Electrical Engineering at the University of Applied Sciences in Zagreb, are based on the Moodle e-learning system. Generally speaking, there are always pros and cons when e-learning is considered. Students have access to all teaching materials, tasks and direct communication with the teacher at all times. On the other hand, if there are problems, it is hard for the teacher to distinguish the exact cause. Students may encounter problems in understanding the materials or in the use of instruments and computer applications; without direct contact, it is virtually impossible for the teacher to motivate them to continue working despite the difficulties. Another challenge for the teacher is detecting which parts of the subject are most interesting to the students and which parts demand more attention and maybe different methodologies. Using blended learning, combining the advantages of both e-learning and person to person teaching / learning, it is possible to achieve a better effect for the mutual benefit. This paper presents the teachers experience and students perception of blended learning as well as assessment system.

I. INTRODUCTION

New IT technologies are being used in education for years, and they are especially characteristic for higher education. Recently, the combination of classical way of education (face-to-face, brick-a-mortar, chalk-and-talk) and e-learning is becoming more and more popular. That combination is often called blended learning, as well as hybrid learning. There are different definitions of blended learning [1], [2], [3], [4], [5], but generally it can be said that it is a combination of classical and technology mediated learning [2]. Speaking from our own experience [6], [7] and definitions mentioned above; it could be said that the phrase „blended learning“ implies a formal educational system that combines on-line and face-to-face lectures (or knowledge transfer in any possible meaning) with assessment system. All this can be achieved by applying different teaching and assessment methods [5], [6], [7], and by different ways of preparing for the exercises, availability and possibilities for practising and learning.

Based on these experiences and models mentioned in the literature, one can distinguish several forms of blended learning. In the first form the teacher, working in person with the students, notices a strong interest or necessity for additional clarifying, and gives customised additional content for each student (in the laboratory or on-line to work at home). In the second form, the students attend lectures and exercises according to the given schedule, while all of the materials are available online in learning management system (LMS). Different construction assignments are given to each student, through LMS, and they need to solve them using prior gained knowledge and online support. And the third form, in which the students prepare for classes from online materials, and the lectures only increase the level of understanding. In that form students do the exercises independently, online, from home. Although the literature mentions several ways of organizing blended learning, the essence are these three forms. Different combinations and use of each individual component of these three ways are also possible. In the PCA course the second method of blended learning organization is mostly used.

II. ORGANIZATION OF THE PCA COURSE USING BLENDED LEARNING ENVIRONMENT

The teaching and assessment system on the PCA (Personal Computers Applications) course, at the professional study of the Electrical engineering at the University of Applied Sciences in Zagreb, are based on the ideas mentioned in previous chapter. Lectures, laboratory and construction exercises on the PCA course are the parts of blended learning environment which consist of general and personalised instructions, practical and individual work for each student.

Since the course is at the beginning of study, it includes general IT and computing concepts, possibilities, and basic work principles of parts and subsystems in a computer. Also, very important part is the practical work with computer applications which can be of great importance to future engineers. Practical work is individual; each student has their own computer, so it is necessary that they come to the exercises well prepared for the current subject. To assure that, they have constant access to the materials for learning and practising (through Moodle e-learning system) and computer applications (use of free or demo software) [6].

Basic use of computers is not easy to present to the participants who come from different backgrounds. They had different availability of information technology and the Internet, thus varying degrees of knowledge. Their previous interest in the subject can not be ignored as well [6]. The personal contact between the students and the teacher helps to detect students' sphere of interest, their motivation and enables teacher to try to encourage and
motivate students. These are the reasons why the PCA course is designed in the blended learning environment.

First part, of the blended learning environment in the PCA course, are the lectures. Materials – slides for the lectures are available, even before the lectures, in Moodle e-learning system. Web links and a list of additional literature with detailed explanations of terminology, work principles etc. are a part of the slides. Lectures are held, face -to- face, in two relatively large groups (around 100 students in each group), where students can actively participate, ask questions and further explanations.

Second part are the laboratory exercises. Materials needed for the preparation before the exercise, are also available through Moodle. The laboratory exercises are held in smaller groups (around 12 students in each group), so each student works on their own computer. At the beginning of the exercise, the teacher explains the goals, purpose and the way the exercise will be done. Then, the work with a certain application is presented, with the emphasis on the most important parts which the students might need in further work. After that, the students practice working with the application on their own, according to the given instructions. The teacher is in the laboratory the whole time, and is available for all the possible questions – for those students who need extra help, and for those who are interested for more advanced uses of the application.

There are also construction exercises, which are the completely individual student work. Students need to write a simple programming code; using all of the previously gained knowledge and skills; using materials available and sharing experiences with their colleagues.

Blended learning environment has, through the years, proved to be the most efficient way for organizing and administering the course, and assessing students' knowledge. Initially, a lot of time is required for the design, preparation and organization of such a system, the creation and adaptation of necessary teaching materials. Details regarding to certain specific features of material preparation, assuring that the computer applications used in the classes are available for the students to practice at home, as well as system administration and system assessment are outlined and described in [6] and [7].

Creating such a system is never quite finished: over the years, occasional corrections are needed – changes in modalities of organization, administration and ways of processing the topics, all based on empirical indicators. Although there is always a need for regular improvements and modernization (it is on the computer, so constant change is normal), the use of blended learning environment after a few years begins to bear benefit: as for the time, and as far for the resources (space, energy consumption, working hours...) and perhaps most importantly - helps students, in the most simple way, gain necessary knowledge and skills. In the next chapter, perceptions of consumers (students) of blended learning will be discussed. That includes a comparison with the conventional lectures and full e-learning system, and their perceptions of the usefulness of this type of organization of teaching and examination system on the PCA course.

III. STUDENTS' EXPERIENCE IN USING BLENDED LEARNING ENVIRONMENT

Students, during their education, encounter different ways the organization of teaching and assessment. How do students perceive this way the organization of teaching and assessment system on the PCA course? What are the good sides and what are not so good sides of this environment? What do they find extremely important and interesting, what they think is not as important or interesting, and what makes them want to work and know more? Quantitative research on this subject was conducted among the students at the PCA course, at the end of the semester in a form of a survey with 11 multiple choice questions – some single answer and some multiple answers, without ranking. The survey was created through Google forms, which ensured anonymity, and the link on it was available for students through Moodle. There are 216 students enrolled in the PCA course, in the academic year 2014./15., and 153 (randomly chosen) of them completed the survey. The questions regarding pure e-learning and chalk and talk were referring to their experiences in general, while the questions regarding blended learning were referring on their experiences on the PCA course. That way, it can be determined how students perceive blended learning on the PCA course in comparison to chalk and talk methods which are still standard in education. The survey was in Croatian language, so it appears in figures shown in this paper, as it is the mother tongue of almost all of the students.

A. E-learning – pros and cons

Question regarding the technologies, which do they find most acceptable for learning and most useful way of transmitting / collecting information and knowledge, was chosen as a starting point. Computer with the Internet connection for 76.47% of the responders represents the most useful and most used medium for this particular purpose. Just a little more then one fifth of them (22.88%) considered books and printed materials the most important and most useful for transmitting and collecting information. Interestingly, less than 1% considered the same for TV. Based on this result, it is obvious that it is very important for the students, in information gathering and learning, to have a computer available materials and lessons (lectures). Considering the extremely high percentage, this fact can be further used to design more materials to prepare for the lectures and learning.

![Figure 1 Which technologies do students use for learning?](image)
Therefore, students were asked if they have, and how completely independently and actively, used pure e-learning in any form (lessons, lectures, exercises...). Question considered any subject or area, the important thing was that the materials were only accessible via computer with Internet connection, such as for example: khanacademy.org, tonmilun.com, tesla.carnet.hr or YouTube in terms of tips & tricks how to work with some computer applications. This way of learning is often used by 9.80% of students but 3 times more (30.72%) never used pure e-learning. Pure e-learning was occasionally, therefore rarely, used by 59.48% of responders. Thus, a total of more than 90% of responders never or rarely used computers available materials for independent learning. Seemingly, this is in contrast with the fact that for them almost 77% of them the computer with an Internet connection is the most important and useful access to information and knowledge. However, this is completely independent learning, occasionally or never practised more than 90% of students, and these two data are not to be confused.

As major drawbacks or limitations of pure e-learning system [multiple answers could be checked] those who regularly or occasionally used it (9.80% of them often and 59.48% of them occasionally), a total of 69.28% reported the one-way communication (52.29%) and the inability to verify the quantity and quality of learned material (38.56%). Respondents also find sociological component significant, the inability of consultations with fellow students when learning is the limiting factor of e-learning for a third of the population (33.97%). A minority (1.3%) considered material unavailability due to works on the network or slow web link as a big limitation.

However, two-thirds of these students (69.28%) who are periodically or regularly using e-learning system for independent learning, as the biggest advantages of this way of learning lists current and easy access to the requested material (55.56%). The possibility of repeating the lessons (replay) is important to 49.02% of the students. Ability to access materials from anywhere at any time of the day (and night) is considered an advantage for 48.37% of the responders. For a third of respondents (32.68%) it is important that the all of the materials are concentrated in one place - everything needed is accessible within a few clicks.

B. Chalk-and-talk - pros and cons

In a specific time in a specific place, lectures are held ex cathedra, exercises in groups, chalk and black board or marker and white board, tests corrected manually, results available to students in a couple of days. It's hard to keep track of own achievements, especially in several courses with different modes of evaluation, which is not in accordance with the Bologna process in higher education. This is a general and brief factual description of the traditional, classic, way of teaching that still prevails in the professional study programs at the University of applied sciences in Zagreb.

When asked to highlight the most important disadvantages of this, traditional way of teaching organization and assessment system, students have pointed out the murmur and similar distractions in class when the more people are attending the lectures (49.02%). The next greatest shortcoming in students’ opinion is that the subjectivity of teachers can affect the grade (48.37%). The fact that they have to come to a specific place at a specific time is a disadvantage for a little more than one third of the population (36.60%), and almost the same percentage (35.29%) feels that the deficiency is the emphasis on aural rather than the visual. Despite the shortcomings, this system of teaching was considered the best for one third of the student population (34.64%) but only if it is performed in small groups.

Of the advantages of the classic ways of organizing teaching and assessment system, students with very high percentage emphasize the interactivity with the teacher (73.20%), therefore, they very highly appreciate and the possibility of direct personal communication with the teacher. Next in significance to them is another sociological component: the possibility of direct and personal communication with their fellow students (59.48%). On the third place in order of importance is also another sociological component: the possibility of the experience transfer (from teachers to the students) in the work or when meeting a certain phenomena (35.29%).

Looking at these results, concerning the classical way of teaching, it can be concluded that it is a way of teaching that fits the students but only if it is a small group. This is concluded on the basis of direct claims of a third of students (34.64%) and based on a high percentage of them who considered direct contact with the teacher (73.20%) and colleagues (59.48%) to be the most important. Of course, this kind of teaching with small groups is not possible to organize in the mandatory courses, especially in first two years of the study where there is a lot of students. Sometimes it is possible to organise classes in this way, for some elective courses in the third year of the study, which enrolled a small number of students.
Since the Bologna process requires continuous monitoring of students, the students were asked to evaluate the importance of constant availability of their achievements, but also a plan of lectures and exercises visible in advance so they can plan their tasks and activities. This is, of course, possible to enable only using computers. 55.55% of the respondents considered this important and useful in this kind of organization. For the majority of students, even 83.00%, speed of assessing their tests and the availability of the results as soon as possible is very important and useful.

The attitude of students towards the role and influence of teachers in the evaluation process is particularly interesting: for the 39.87% of them it is an advantage that in tests which are assessed automatically, by the computer, the subjectivity of teachers is eliminated. However, even 47.06% of students considered it important that, despite the fact that the computer evaluates the tests, the teacher can intervene in the assessment at their sole discretion. E.g., if the boundary for the pass is set on 50.00%, the border can be moved to 49.65% by teacher’s intervention.

Finally, the study was concluded with a personal impression of students, which manner of class organisation and the assessment system encouraged them to learn more, to achieve better grades and to acquire new skills. Even 73.86% of the population believes it is blended learning environment, compared with 9.15% who thought the traditional manner. Others (16.99%) found it difficult to assess.

IV. CONCLUSION

Blended learning can not be considered as a mere sum of two ways of teaching organization, it can not be regarded as the classic method of teaching with added e-learning component. Or vice versa; e-learning with possible consultations. In the organization, implementation, application and interpretation of blended learning environment is required a holistic approach. Part of the results of the research indicates it, such as the one about the role of computers and teachers in the evaluation process. This research can not be considered exhaustive or final. It has only discovered and opened new questions that deserve to be answered. For example, students (in the part of useful segments in blended learning environment) were asked to assess how important is the ability to communicate with the teacher and outside the class schedule and consultation. This was considered important and useful for 44.44% of students. Without denying that sometimes indeed there is such a need (communication with the teacher outside the class schedule and consultation), one might reasonably ask is this, at least in part, a reflection of students’ poor organization of their own time? Or dependence in work and learning when they expect regular incentives by the teacher? To search for answers to these and similar questions, it is needed to carry out extensive research over several generations.

Organisation of the course - lectures, exercises and assessment system is a consequence of the number of students in this course and the subject matter. In the study
of electrical engineering, one of the key segments is the practical work with instruments and a variety of computer applications. This conditions the organization of teaching and assessment system on each professional course. The fact is that the PCA course annually enrols more than 200 students and that they should master practical work with a variety of computer applications. This should be done regardless of their different backgrounds, as for the interests and their own skills to work with computers. Experiences have shown that this type of organization of teaching, exercises and assessment system is very efficient in these situations. The conducted survey confirms this. This regime has been applied for seven years on this course. It would be interesting to accurately calculate and show how much benefit for the institution (University of applied sciences in Zagreb) this brought, how many teaching hours have been saved, as reduced energy consumption.

Results of this study suggest that everything possible in the process of organization of teaching and assessment systems should be organized in the e-learning system. Some of the examples are: preliminary exams and regular exams, records of attendance and other types of administration, materials for attending lectures and preparation for the exercises. Space where students can upload their work (such as seminar papers) should be available as well. Besides the advantages for the teachers, less paperwork being the biggest advantage, the results of research directly indicate the benefits of the online available materials (section III A). Considering that for almost 77% of the respondents computer with an Internet connection is the main way of transmitting information and knowledge, over the next academic years it would be useful to create video clips with instructions for the use of certain tools and software, explanations of some computer terms and procedures. Almost 74% of respondents stated that blended learning encourages them to learn, acquire knowledge and skills and ultimately achieve better-marks which motivates the teachers to continue working and developing in these areas. Research will be repeated in the few next academic years to monitor and compare the results, and after a number of years to make a comparative analysis with a definite conclusion.

**Literature**


